

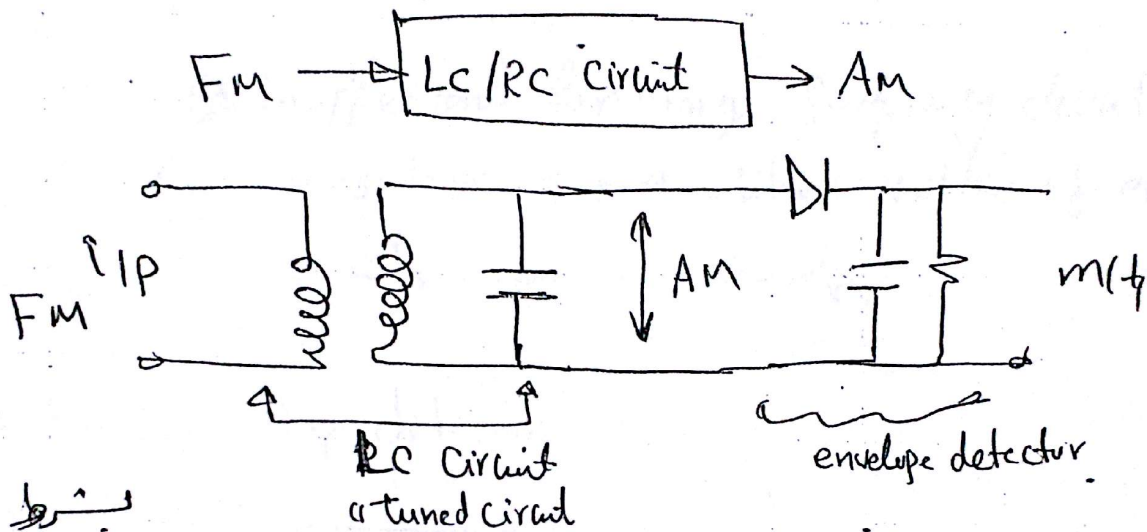
FM Demodulators

3

الطريقة
المعيرة

② Slope detector:

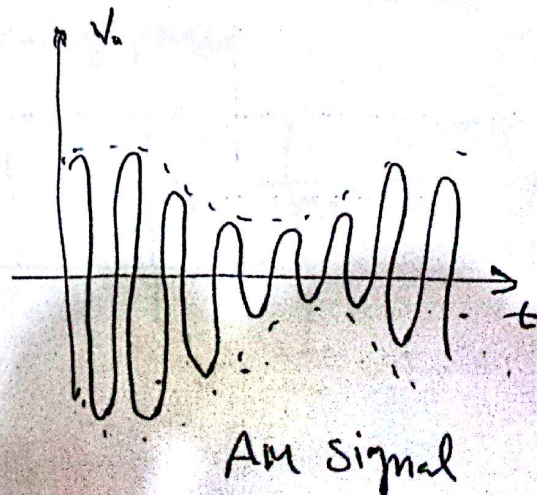
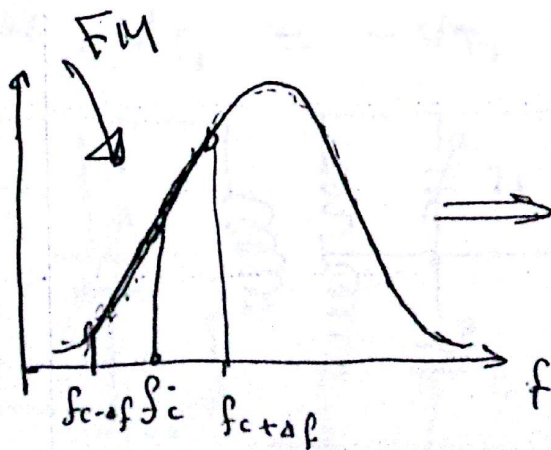
وهو أحد أنواع detectors. يستعمل L و C و R و m و p tuned circuit والتي تقوم بتحويل التغير في التردد إلى تغير في m



نلاحظ

the tuned circuit has linear range

: The carrier frequency f_c should lie in the middle of the linear region



1

$$f_{\min} \leftarrow f_c \rightarrow f_{\max}$$

$$= f_c - \Delta f \quad \quad \quad f_c \quad \quad \quad = f_c + \Delta f$$

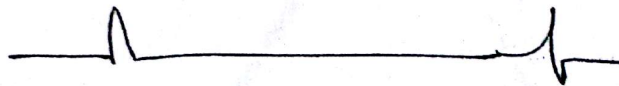
$$\Delta f = k_f A_m$$

Disadvantage

① The tuned circuit has small linear range which limits max frequency deviation

② Inefficient for large frequency deviation

③ Sensitive for Amplitude variation of m(t)



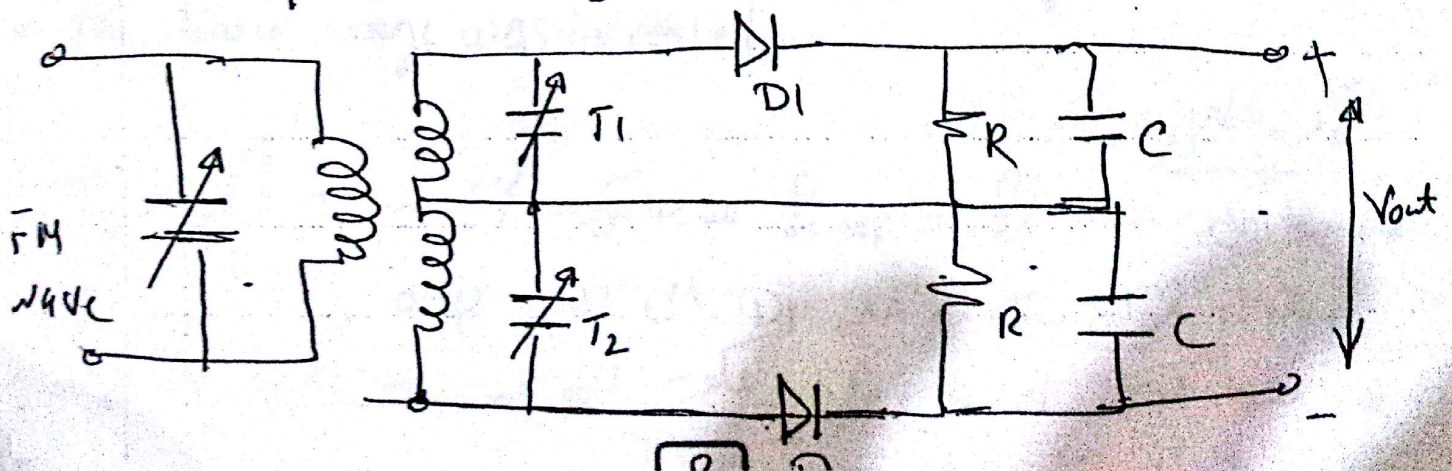
3) Balanced slope detector

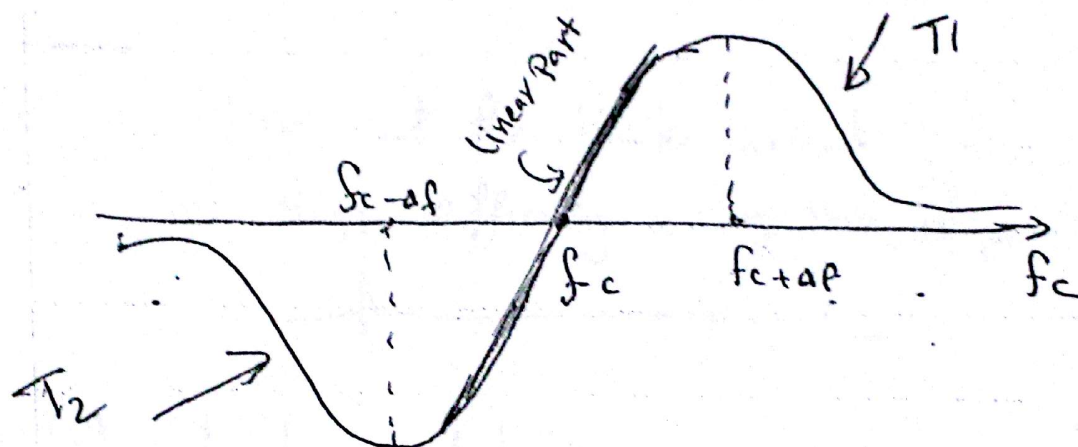
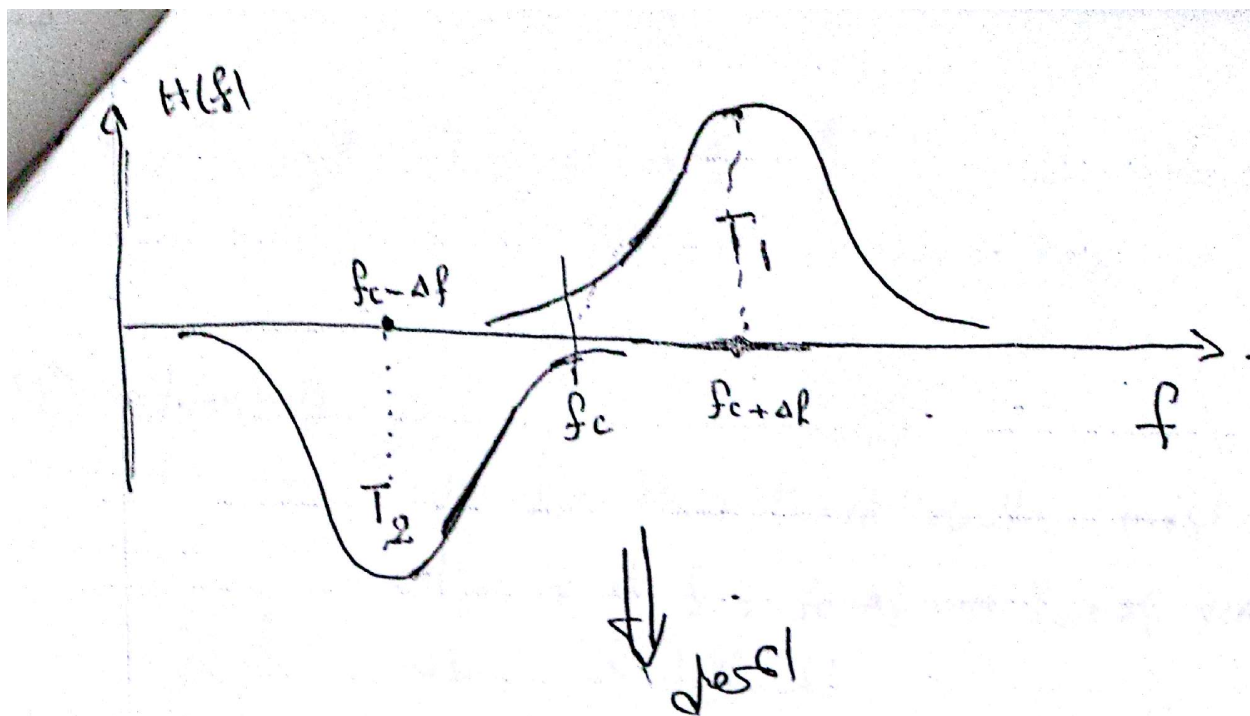
Consists of 1) a tuned circuit (primary) & 2) two secondary tuned circuits

1) Primary tuned circuit tuned at f_c

2) two secondary tuned circuits tuned at $f_c + \Delta f$ and $f_c - \Delta f$

So, $V_{T_1} = -V_{T_2} \Rightarrow$ out of phase





مع مراعات الآتي

- * Tuned Circuit 1 Tuned at $f_c - \Delta f \rightarrow T_2$
- * " " 2 " " $f_c + \Delta f \Rightarrow T_1$
- * the linear range was increased

فكره العمل

عندما يكون $f_i = f_c + \Delta f$ عندها يكون الإخراج T_1 أكبر من T_2
 وبالعكس عندما يكون $f_i = f_c - \Delta f$ يكون الإخراج T_2 أكبر من T_1
 وبذلك يتم الاستجابة عند f_i أي Δf أو Δf أو Δf

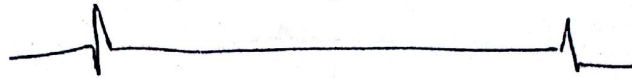
ويعني $f_i = f_c$ $V_0 = 0$ $T_2 = T_1$

Disadvantage

We use three tuned circuits must be adjusted at f_c , $f_c - \Delta f$ and $f_c + \Delta f$ very well which is difficult

Advantage

- ① no need for limiter circuit
- ② High efficiency (Large linear range)

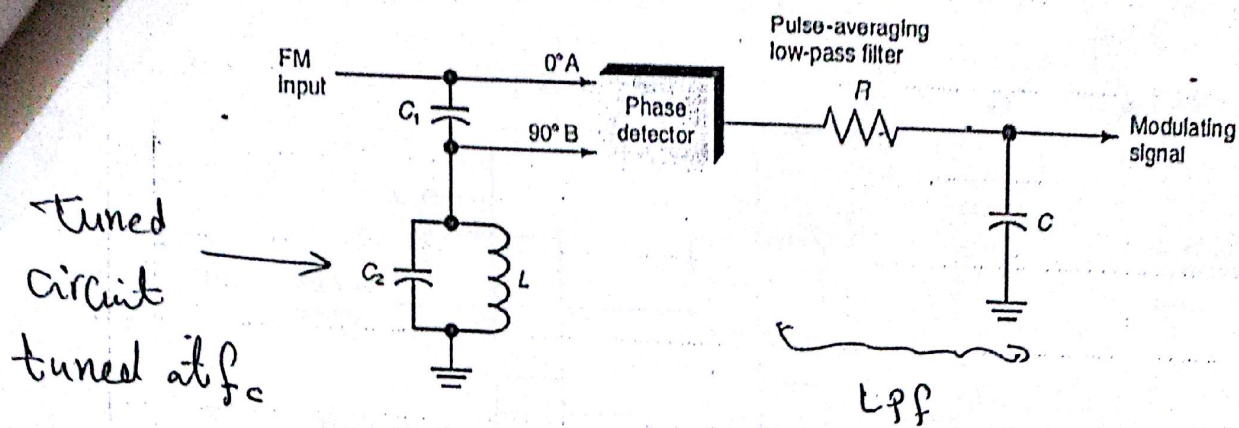


④ Quadrature detector

والذي فيه يتم إتمام phase shift circuit 90° عن غير المعالجة carrier unmodulated

والتى فيه يتم إتمام 90° phase shift مع tuned circuit C_1 والذى فيه يتم إتمام 90° phase shift





The circuit consist of

- ① Tuned circuit centered at f_c
- ② Small Capacitor C_1 to provide 90° phase shift
- ③ phase detector
- ④ o/p RC circuit act as Lpf

Circuit operation

Case 1 unmodulated wave $\Rightarrow$ FM wave = Carrier

Carrier tuned in the circuit (B) 90° phase shift $\Rightarrow$ output is zero

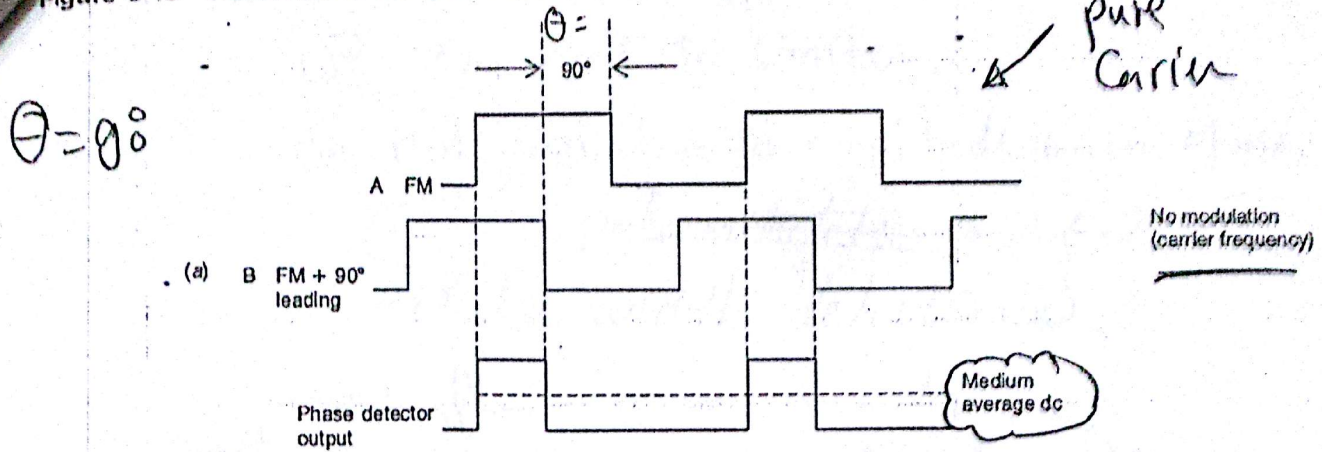
Carrier $\Rightarrow$ A is the input $\Rightarrow$ B is the output $\Rightarrow$ 90° phase shift

Phase detector $\Rightarrow$ A $<$ B $\Rightarrow$ output is positive

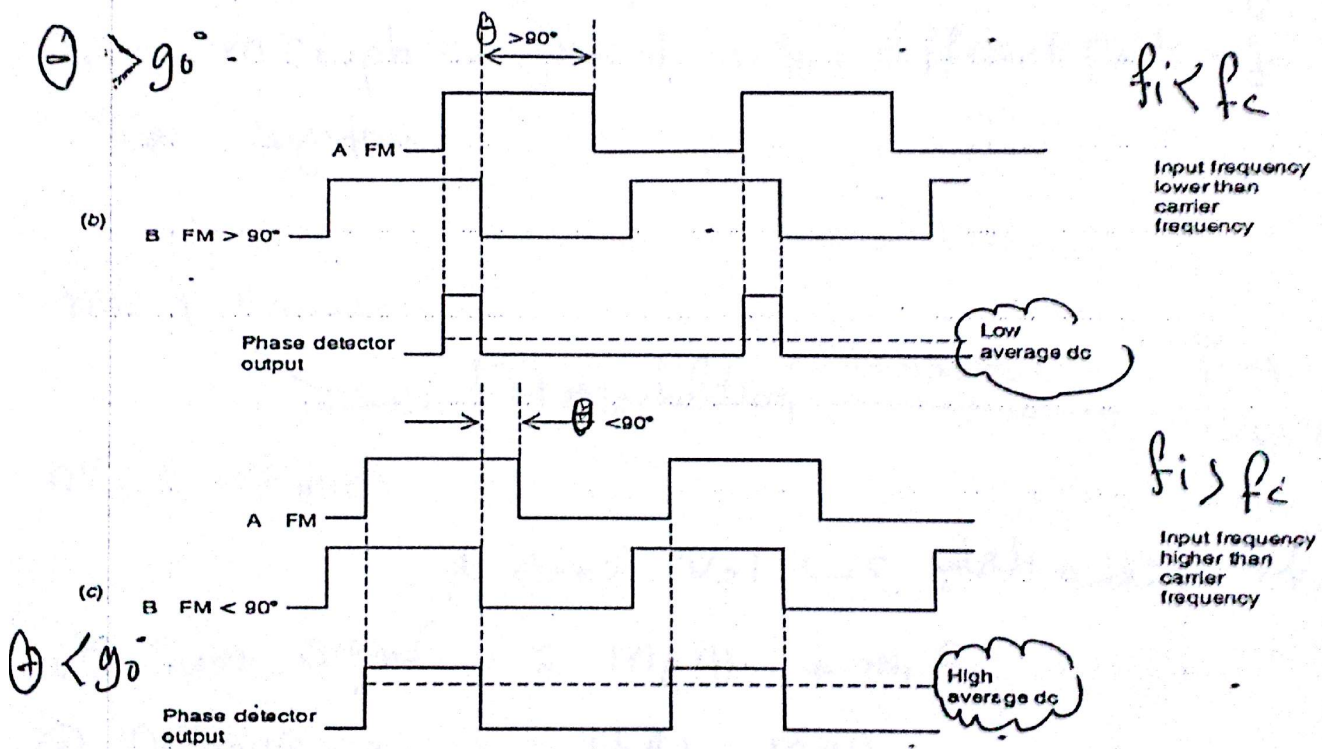
Phase shift $\Rightarrow$ output is negative

RC filter $\Rightarrow$ DC voltage

Figure 6-16 Waveforms in the quadrature detector.



Case 2: When frequency modulation occurs the carrier frequency deviates above and below the resonant frequency of the tuned circuit, resulting in an increasing or a decreasing amount of phase shift between the input and the output



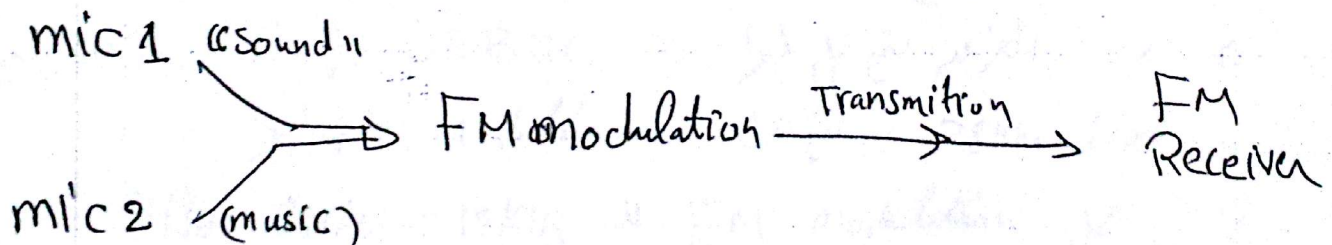
عن عمل Fm Carrier modulation نلاحظ تردد ال Carrier يزيد
يقل عن f_c ال tuned دوائر يقل او يزيد ال phase A
دوائر نلاحظ انه كلما ال average Dc انخفضت ال phase detector
تغير والى تفرع ال $m(t)$

van tuss

- ① we use only one tuned circuit.
- ② No need to limiter
- ③ not sensitive to amplitude variation of MA,
~~pulse width detection~~ is present,
 pulse width detection.

FM stereo Broadcasting

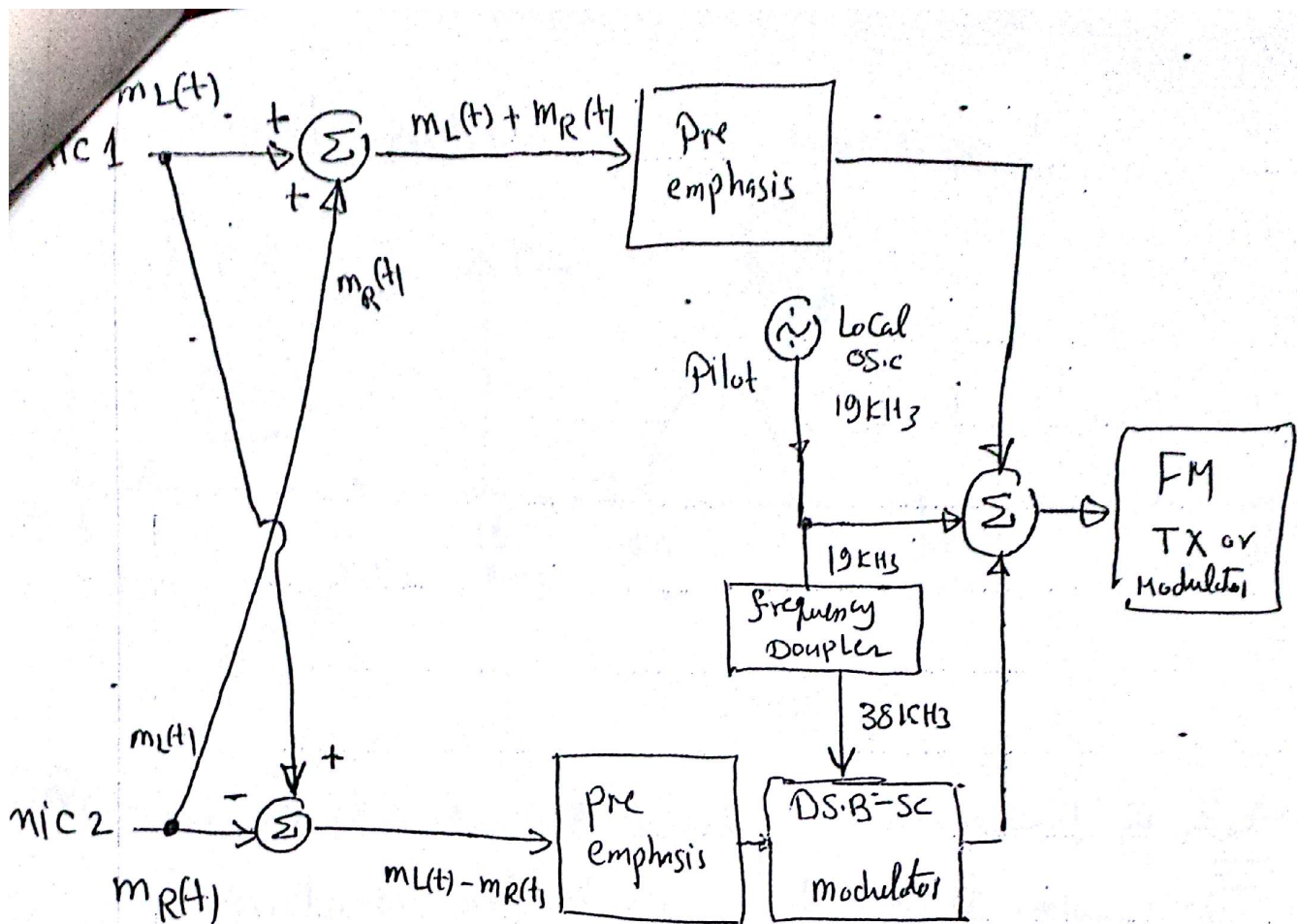
In which the i/p signal $x_m(t)$ is produced by two microphones placed in two different parts of the system



۲۰۱۸-۱۹ کے لیے ایف ڈی ایف کی شرح

- ① Sum signal $= m_R(t) + m_L(t)$
- ② Difference " $= m_L(t) - m_R(t)$
- ③ Carrier at $f_c = 19\text{ kHz}$ " pilot "

معرفه این ال Bur اُصا ب $m(H)$ سوا L or R
 لایه 151CH_3
 7



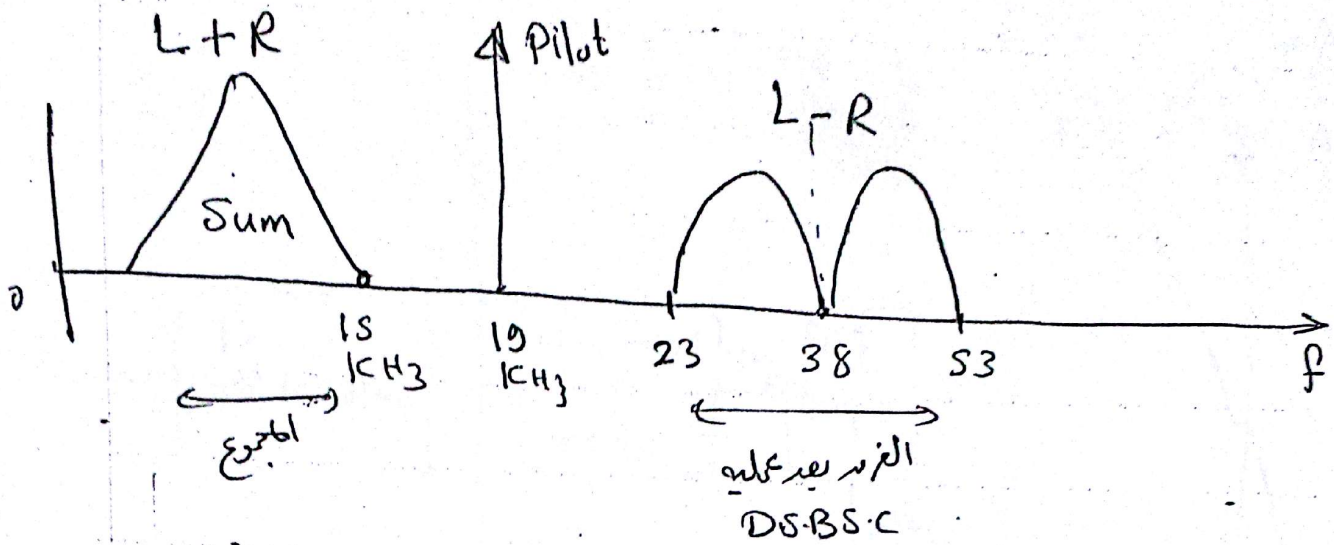
به این شکل به نظر می آید

- ۱) اشاره المجموع فرکانس ای ال FM Modulator
- ۲) // الغرض به عمل لای DS-BSC به استخدام تردد بیست و دو کیلوهرتز
- ۳) حوالی ۳۸ کیلوهرتز به عمل FM Modulation
- ۴) به عمل FM Modulation و Pilot Carrier = ۱۹ کیلوهرتز

$$\therefore \text{Composite } m(t) = [\text{Sum} + \text{Diff after modulation} + \text{Pilot}]$$

۵) به عمل FM mod لای اشاره ال به
 عند تردد ۱۰۰ MHz و ۵۰ MHz ای
 تردد فرکانس ال FM

Signal spectrum of FM Stereo signal



مكتوب يتم إرجاع ال Pilot في نتيجه في ال Receiver
Synchronous detection. التي يستخدم في عمله ال

Stereo FM Receiver

* وفيه يتم استقبال الإشارة ال FM signal عن طريق
ال tuned circuit ثم تحويلها من f_c إلى f_{IF} عن طريق ال Mixer ثم
تدويرها ال Discriminator لكي يعمل Detection وننتج منها
المرتبعة مرة أخرى.

- * يتم استخدام مجموعة من ال filters لفصل كل جزء على حدة
- ① LPF $\rightarrow$ to obtain Sum signal (L+R)
 - ② BPF around (23 : 53) kHz to obtain the difference (DS-SS-C)
 - ③ BPF around 19 kHz

